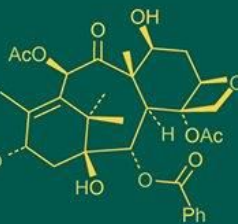
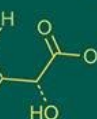


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693

ISSN Online: 2617-4707

IJABR 2024; 8(11): 506-510

www.biochemjournal.com

Received: 22-08-2024

Accepted: 24-09-2024

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Comparative biology of mustard sawfly *Athalia proxima* (Klug) on mustard and radish

Shailesh D Patel and Manvi AggarwalDOI: <https://doi.org/10.33545/26174693.2024.v8.i11g.2888>**Abstract**

Laboratory studies on the comparative biology of mustard sawfly, *Athalia proxima* (Hymenoptera: Tenthredinidae) on mustard and radish were conducted. The average incubation period was 4.64 ± 0.76 days on mustard and 4.96 ± 0.79 days on radish. An average of 89.00 per cent and 88.00 per cent hatching was observed on mustard and radish, respectively. The total larval period was 13.00 ± 1.26 days and 12.40 ± 1.38 days on mustard and radish, respectively. The average pupal period on mustard and radish was 10.16 ± 0.98 days and 10.04 ± 1.43 days, respectively. The fecundity of the female adults on mustard and radish was 80.00 ± 12.76 eggs and 55.89 ± 18.97 eggs, respectively. The pre-oviposition period lasted for an average of 4.17 ± 0.72 hours and 3.00 ± 1.13 hours on mustard and radish, respectively. The oviposition period lasted for an average of 9.25 ± 1.22 days on mustard, whereas on radish, it lasted for 7.50 ± 2.15 days. The average post-oviposition period was 2.08 ± 0.67 days and 2.00 ± 0.74 days on mustard and radish, respectively. The total life cycle of the male mustard sawfly was completed in 38.60 ± 2.72 days on mustard while on radish, it was completed in 37.00 ± 3.02 days. The female sawfly lived for 41.50 ± 2.32 days on mustard, whereas on radish, it lived for 40.60 ± 3.03 days.

Keywords: Biology, mustard sawfly, life cycle, life stages, morphology**Introduction**

The mustard sawfly, *Athalia proxima* (Klug) [= *Athalia lugens proxima* (Klug)] (Hymenoptera: Tenthredinidae) is a polyphagous insect and is considered a devastating pest of vegetables in India. It mainly remains active during the cold weather from October to March. The larva alone is the most destructive stage and feeds on the margin of the leaves towards the centre. The later instars make holes, preferably on the younger leaves, and skeletonize them. Sometimes they also feed on the epidermis of the tender shoots, flowers and fruits (Chauhan & Shukla, 2014) ^[2]. Host plants influence the survival, the intensity of consumption of the larvae (Suzana *et al.* 2015) ^[12] and the fecundity and longevity of adults (Yongming & Kunjun, 2001; Kulkarni *et al.* 2004) ^[14, 5]. The differences in morphological and chemical substance between host plants may likely interfere with the biology and behaviour of pest (Narvekar *et al.* 2018) ^[6]. Therefore, the present investigation was carried out to study the comparative biology of *A. proxima* on two different hosts *i.e.* mustard and radish under laboratory conditions.

Materials and Methods

Studies on the comparative biology of mustard sawfly on mustard and radish was carried out under laboratory conditions at AICRP on Biological Control of Crop Pests, Anand Agricultural University, Anand, Gujarat during November, 2022 to February, 2023. During the study period, the average temperature and relative humidity was 25.30 ± 0.82 °C and 48.30 ± 2.45 per cent, respectively. To initiate the culture of *A. proxima*, larvae were collected from the fields of mustard and radish grown at different places at Anand Agricultural University, Anand. The collected larvae were kept for rearing in separate circular iron cages (diameter: 36 cm, height: 12 cm) having a layer of moist soil at the bottom. Fresh mustard and radish leaves were provided daily in the morning as food to the larvae in their respective cages. After the pupation of larvae, the soil at the bottom of the cages was removed and sieved to separate the earthen cocoons which were further kept in adult rearing cages (length: 30 cm, breadth: 30 cm, height: 30 cm).

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After the emergence of adults, conical flasks (capacity: 100 ml) were taken and they were partially filled with water. Approximately, 30 to 40 day old plants of radish and mustard were placed inside the conical flasks in a such way that their roots remained inside water. Only one plant of either mustard or radish was put inside the flask. After this, the flasks were placed in respective cages for egg laying. Fresh eggs laid by the females inside the tissues of leaves of radish and mustard were used to study different parameters of biology as well as to maintain the mass culture of *A. proxima* on mustard and radish.

To record the incubation period, separate conical flasks (capacity: 100 ml) were taken and partially filled with tap water. Fresh mustard and radish plants were placed in the flasks in such a way that their roots remained inside the conical flasks. The conical flasks were kept inside the rearing cages. Five pairs of male and female adults were taken from the mass culture during early morning and released into the rearing cages. Adults were allowed to lay eggs upto evening. After that they were removed. These plants were observed daily in the morning and evening for hatching of eggs. The larvae hatching out from the eggs were used for the further study.

To study hatching percentage, 100 eggs laid inside the leaf tissues were critically examined daily in the morning and evening for a period of seven days. Based on the number of larvae hatched, the hatching percentage was calculated.

To study the number and duration of different larval instars, freshly hatched 25 larvae were transferred and confined individually in perforated plastic specimen vials (diameter: 5.5 cm, height: 4.5 cm). Fresh mustard and radish leaves were provided inside the respective vials as food. The larvae were observed daily for the change of instar. The change of instar was confirmed by the presence of exuviae. The total larval period was calculated based on the date of egg hatching and the date of formation of pre-pupa.

When the fully grown larvae stopped feeding, contracted and became darker. They were considered to have entered the pre-pupal stage. The duration of the pre-pupal period was also calculated.

The earthen cocoons were carefully broken with the help of a clean dissecting needle and the pupae were obtained. Pupal period was calculated from the date of formation of the cocoon till the date of emergence of the adult.

Freshly emerged male and female adults were paired and a single pair was confined in adult rearing cages (length: 30 cm, breadth: 30 cm, height: 30 cm). A swab of absorbent cotton dipped in five per cent honey solution was placed at the base of each cage as food for adults. The swabs were changed daily. Plants of mustard and radish kept in partially filled conical flasks (capacity: 100 ml) were provided in the respective cages for egg laying. The plants were changed on daily basis. The replaced plants were observed under binocular microscope for the presence of slits and the number of slits were counted. The number of slits was considered as the number of eggs laid by the female. Pre-oviposition period was calculated from the date of emergence of adults to the date of initiation of egg laying. The oviposition period was calculated from the date of initiation of egg laying to the date of ceasing of egg laying.

Post-oviposition period was calculated from the date of ceasing of egg laying to the death of the female. Longevity of male and female was calculated separately from the date of emergence till the date of death of the adult.

For determining the sex ratio, male and female adults emerged from laboratory reared larvae were separated based on presence or absence of the saw-like ovipositor. The total life cycle was calculated based on the date of egg laying and date of death of adult.

Independent two-sample t-test was carried out to compare the biology of *A. proxima* on the two hosts.

Results and Discussion

The results of this study are indicated in Table 1 and illustrated with the help of photographs in Fig.1

Egg: The female adults laid eggs singly inside the leaf tissues on the lower surface around the margin of the leaves of both mustard and radish by making a slit like incision on the leaf with the help of its saw-like ovipositor. Similar findings regarding the egg laying site of *A. proxima* have been reported by Jagtap and Kadam (1978) [3], Patel (1995) [7], Sumithramma *et al.* (1997) [11], Bhatt (2000) [1] and Sahu *et al.* (2018) [10].

The incubation period ranged from 4 to 6 days on mustard and from 4 to 7 days on radish with an average of 4.64 ± 0.76 days on mustard and 4.96 ± 0.79 days on radish indicating no significant difference in the incubation period of eggs between the two hosts. The present findings are similar to the reports of Sumithramma *et al.* (1997) [11], who reported that the average incubation period was 5.05 days and 5.60 days in mustard and radish, respectively.

An average of 89.00 per cent and 88.00 per cent hatching was observed on mustard and radish, respectively. Previously, Bhatt (2000) [1] and Ramoliya (2008) [8] found almost similar results on the hatching percentage when reared on mustard (89.39%) and radish (88.17%), respectively.

Larva: The larvae of *A. proxima* passed through six instars when reared either on mustard or radish. Earlier, six larval instars of *A. proxima* have also been reported by Patel (1995) [7], Rohilla and Kumar (1991) [9], Bhatt (2000) [1] and Thigale and Pawar (2021) [13]. Information regarding the duration of various larval stages are mentioned in Table 1.

The freshly emerged first instar larva was greyish green in colour. The second larval instar was slightly bigger and more greenish than the first larval instar. The third larval instar turned black in colour and prominent black dots were observed on the lateral side of each segment of the thorax and abdomen. The third instar larva was more active and fed more than the previous two instars. The fourth instar larva was similar to the third instar larva, except it was bigger in size. The fifth instar larva was bigger and even more blackish in colour than the fourth instar larva. The black dots on the thorax and abdomen were observed to be bigger in size in this instar. The sixth larval instar was black and thicker in appearance than the previous instars.

Seven pairs of prolegs were clearly visible on the lateral side of the body in addition to the three pairs of thoracic legs.

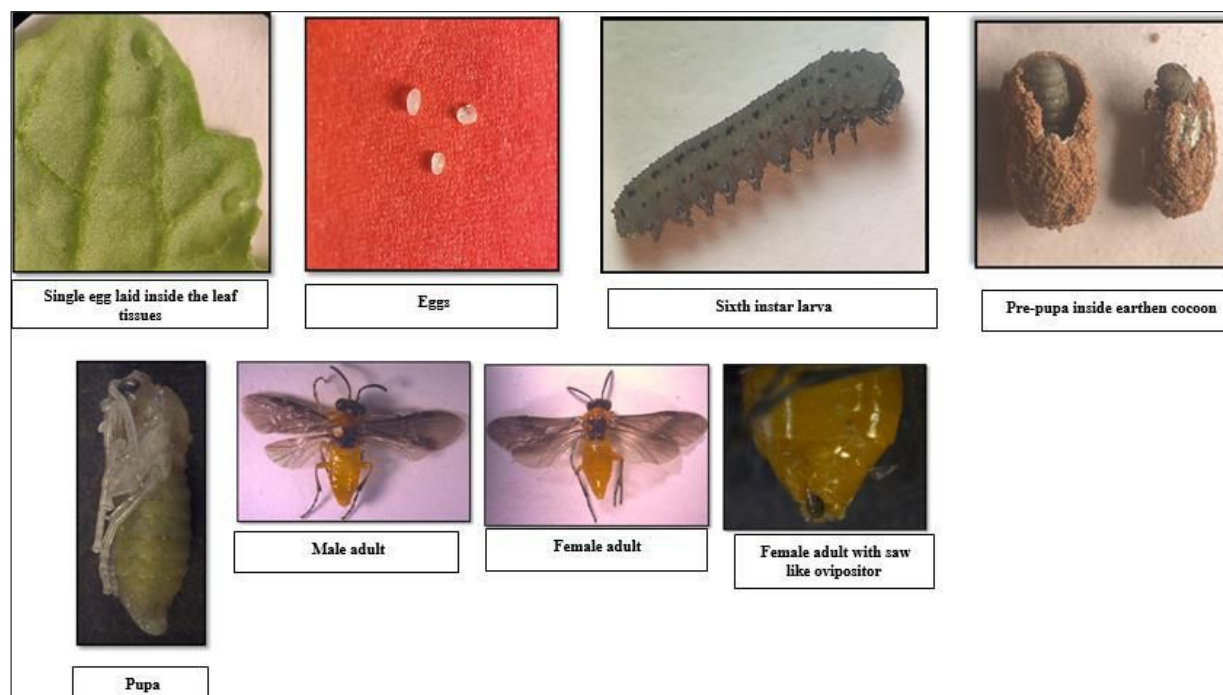


Fig 1: Life stages of *A. proxima*

Table 1: Duration of various life stages of mustard sawfly, *A. proxima* under laboratory conditions

Life stages		Duration in day(s)						P value (t-test)
		Mustard			Radish			
		Minimum	Maximum	Mean±SD	Minimum	Maximum	Mean±SD	
Hatching (%)		89.00			88.00			
Egg incubation period		4	6	4.64±0.76	4	7	4.96±0.79	0.150
1 st Instar		2	3	2.44±0.51	1	3	2.32±0.56	0.429
2 nd Instar		2	3	2.28±0.46	1	3	2.12±0.53	0.257
3 rd Instar		2	3	2.20±0.41	1	3	1.84±0.69	0.029*
4 th Instar		2	3	2.32±0.48	2	3	2.20±0.41	0.344
5 th Instar		1	3	2.28±0.74	2	3	2.60±0.50	0.079
6 th Instar		1	2	1.48±0.51	1	2	1.32±0.48	0.257
Total larval period		10	15	13.00±1.26	10	16	12.40±1.38	0.115
Pre-pupal period		3	5	3.96±0.68	3	5	4.00±0.58	0.823
Pupal period		9	12	10.16±0.98	9	14	10.04±1.43	0.724
Pre-oviposition period (hrs)		3	5	4.17±0.72	2	5	3.00±1.13	0.006**
Oviposition period		7	11	9.25±1.22	4	10	7.50±2.15	0.023*
Post-oviposition period		1	3	2.08±0.67	1	3	2.00±0.74	0.775
Fecundity (no. of eggs/female)		55	98	80.00±12.76	35	95	55.89±18.97	0.000**
Longevity	Male	5	8	6.84±0.99	4	8	5.88±1.30	0.005**
	Female	8	11	9.28±0.98	6	12	8.52±1.45	0.035*
Total life cycle	Male	35	43	38.60±2.72	33	42	37.00±3.02	0.229
	Female	38	46	41.50±2.32	39	47	40.60±3.03	0.465
Sex ratio (Male: Female)		1:2.60			1:2.00			

Notes: *Significant by independent two-sample t-test at 5% level of significance

** Highly significant by independent two-sample t-test at 1% level of significance

The total larval duration varied from 10 to 15 (average 13.00±1.26) days when fed on mustard leaves, while, when fed on radish leaves, the total larval duration ranged from 10 to 16 (average 12.40±1.38) days. The difference in total larval duration between the two hosts was non-significant. Earlier, Bhatt (2000) [1] reported that the total larval duration on mustard was 14.27±1.38 days. The total larval duration on radish was 13.00±1.60 days as reported by Ramoliya (2008) [8].

Pre-Pupa: The last larval instar just before going into pupation, stopped feeding, became slightly sluggish and contracted in size. It then entered the soil for pupation and

remained quiescent for some time by constructing an earthen cocoon of soil particles cemented with parchment like secretions of the mouth before turning into the pupa. The pre-pupal period lasted for 3 to 5 days on both the hosts with an average 3.96±0.68 days on mustard and 4.00±0.58 days on radish. The t-test revealed that the duration of pre-pupa did not differ significantly between mustard and radish. Earlier, Sumithamma *et al.* (1997) [11] reported that the average pre-pupal period was 4.70±0.65 days on mustard and 4.50±0.94 days on radish.

Pupa: The pupa was of the exarate type with free body appendages. It was light green in colour with prominent

distinguished dark coloured eyes. The prolegs disappeared but the semi-transparent thoracic legs were clearly visible. Just before the adult emergence, the head turned black and the abdomen turned yellow in colour. Similar observations were previously made by Kapadia *et al.* (1980), Patel (1995) [7], Sumithamma *et al.* (1997) [11] and Bhatt (2000) [1].

The duration of the pupal stage ranged between 9 and 12 days with an average 10.19 ± 0.98 days on mustard, whereas, on radish, it ranged between 9 and 14 (average 10.04 ± 1.43) days. Results of the t-test indicated that the difference in duration of pupa between the two hosts was non-significant. These results are similar to the findings of Sumithamma *et al.* (1997) [11] who reported that the average pupal period was 6.95 ± 1.05 days on mustard and 6.70 ± 0.97 days on radish.

Adult: The adults of *A. proxima* were active fliers. Head of the adults was black in colour and triangular in shape. The prothorax was orange in colour while the meso and meta thorax were black in colour. The abdomen was broad in the middle with a tapering end and was bright yellow in colour. Abdomen of female was bigger in size than that of male. The wings were black and translucent with black veins. The characteristic difference between the male and female adult was the presence of a black 'saw' like ovipositor on the ventral side of the abdominal tip of the female adult which was not present in the male adults. These findings are in accordance with the reports of Kapadia *et al.* (1980), Patel (1995) [7], Sumithamma *et al.* (1997) [11] and Bhatt (2000) [1] who have described the adults of *A. proxima* similarly.

The pre-oviposition period of female was 3 to 5 hours on mustard, whereas it was 2 to 5 hours on radish. The average pre-ovipositional period lasted for 4.10 ± 1.73 hours and 3.00 ± 1.13 hours on mustard and radish, respectively giving a highly significant difference between the two hosts as indicated by the t-test. The oviposition period ranged between 7 and 11 (average 9.11 ± 1.22) days on mustard, whereas on radish, it ranged between 4 and 10 (average 7.50 ± 2.15) days indicating a significant difference between the hosts.

The range of post-oviposition period of the female adults was the same for both mustard and radish and lasted for 1 to 3 days with an average of 2.08 ± 0.67 days and 2.00 ± 0.74 days on mustard and radish, respectively. Previously, Sumithamma *et al.* (1997) [11] have reported similar results according to which the pre-oviposition period lasted for 5.3 and 3.8 hrs on mustard and radish, respectively and the oviposition period lasted for 14.18 and 10.73 days on mustard and radish, respectively.

The fecundity of the *A. proxima* reared on mustard ranged from 55 to 98 eggs with an average of 80.00 ± 12.76 eggs. On radish, the fecundity varied from 35 to 95 (average 55.89 ± 18.97) eggs. Furthermore, the difference in fecundity between the two hosts was found to be highly significant. These results differ from the results of Sumithamma *et al.* (1997) [11] who reported that the average fecundity of females was 169.8 eggs on mustard and 105 eggs on radish. The longevity of the male adult ranged between 5 and 8 (average 6.84 ± 0.99) days and that of the female adult ranged between 8 and 11 with an average 9.28 ± 0.98 days on mustard. Comparatively on radish, the longevity of the male adult was between 4 and 8 (average 5.88 ± 1.30) days and female adult lived for 6 to 12 with an average of 8.52 ± 1.45 days. Difference in male longevity between mustard and

radish was highly significant while those for female longevity were significant only.

Sex ratio: The male to female sex ratio under laboratory conditions was observed to be 1:2.60 and 1:2.00 on mustard and radish, respectively, indicating preponderance of female adults over male adults on both the hosts. Similar study by Sumithamma *et al.* (1997) [11] revealed a sex ratio of 1:3.00 and 1:2.33 on mustard and radish, respectively. Further, Bhatt (2000) [1] and Ramoliya (2008) [8] reported that the male: female sex ratio varied from 1:1.17 to 1:2.33 on mustard and from 1:1.25 to 1:2.10 on radish, respectively.

Total life cycle: The total life cycle of the male mustard sawfly ranged between 35 and 43 (average 39.13 ± 2.80) days on mustard, while on radish, it ranged between 33 and 42 (average 37.00 ± 3.02) days. The female sawfly lived for 38 to 46 (average 41.88 ± 2.47) days on mustard, while on radish, the total life cycle of female sawfly was of 39 to 47 (average 40.60 ± 3.03) days. According to the results of the t-test, both the male and female life cycle did not differ significantly between the two hosts. According to Sumithamma *et al.* (1997) [11], the total life cycle from egg to adult ranged from 27 to 32 days (average 29.10) on mustard and 28 to 31.5 days (average 29.29 days) on radish.

Conclusions

From the present study, it can be concluded that the total life cycle of the male and female mustard sawfly was completed in 38.60 ± 2.72 days and 41.50 ± 2.32 days on mustard, while on radish, it was completed in 37.00 ± 3.02 days and 40.60 ± 3.03 days, respectively.

Acknowledgement

The authors are thankful to the Director of Research and Dean, Post Graduate Studies, Anand Agricultural University, Anand for providing all the necessary facilities and encouragement during the present investigation.

Conflict of interest: The authors declare that they have no conflict of interest.

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